MANITOBA

HISTORICAL AND

Scientific Society.

TRANSACTION No. 3.

Gleanings from the Geology of the Red River Valley.

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MANITOBA FREE PRESS PRINT

RED RIVER VALLEY.

Its Geology discussed before the Historical Society.

SCIENTIFIC VIEW OF THE SURROUNDINGS OF WINNIPEG.

WHERE THE CITY'S WATER SUPPLY SHOULD BE OBTAINED.

OBSERVATIONS ON THE COAL AND OTHER IMPORTANT QUESTIONS.

The regular meeting of the Historical and Scientific Society, Thursday evening, Dec. 28th, was well attended, and interest even greater than usual was manifested in the proceedings.

THE PAPER OF THE EVENING.

Mr. J. H. Panton was then called upon to read his paper Gleanings from the Geology of the Red River Valley, which follows:—

Mr. President and gentlemen: To-night for a short time, we purpose directing your attention to the Book of Nature, and from the fragmentary leaves of the geological records glean something about the rocks beneath our city, and the loose material which overlies them. Rocks may exist in two forms, the solid, which is represented here some fifty feet below the surface, and the pulverized, which, mingled with decomposing vegetable matter, forms the soil of our fields. The solid form is fixed, and has not been removed from its present position since deposited, while the pulverized has in most cases been derived from rocks at a distance. These have been ground down and transported by agencies to which reference will be made afterwards. To say something regarding the nature of these rocks, as they form the foundation of this city, is our object in appearing before you to-night.

The geology of our great North West, like our vast plains and immense rivers, is on a magnificent scale. To the eye of the geologist a grand vision appears, as he contemplates the marvellous panorama that rolls before him, portraying the geological features of the country lying between the Laurentian rocks to our east, and the lofty mountains of the west. The former, representatives of the first rocks to triumph over the universal waters of primeval days and the latter belonging to a period near the summit of the geological series. Between these great natural boundaries, we see stretching before us, the three vast prairie steppes of the North West, rising in succession above each other and distinguished by characteristic physical features.

FIRST PRAIRIE STEPPE,

Known as the Red River Valley, is 52 miles wide at the international boundary line, widening to the north, with an elevation of 800 feet above sea level and embracing an area of 6,900 square miles or over 4,000,000 acres. The last of our country to emerge from water, it has received a rich compensation in the drainage of the North West for countless years, a rich alluvial deposit to which the eyes of the World are turned with astonishment at its almost inexhaustible fertility. In this rich valley abundant harvests are reaped upon fields which have been sown for fifty successive years with wheat, and as yet show no indication of less productive power.

Since our geological gleanings are to refer more particularly to this deposit, as it occurs beneath and around Winnipeg, we shall not dwell at present upon an area

fraught with a great future to the inhabitants of Manitoba.

SECOND PRAIRIE STEPPE.

Following upon the first, the Second Steppe appears with an elevation of 1,600 feet, 250 miles wide at its southern limit and narrowing slightly towards the north.

Within this vast area, are 10,500 square miles of land, more rolling in its character than the preceding district, but also containing vast stretches of prairie land.

The deposits here differ from those of the first steppe, both regarding age and nature. Silurian strata immediately underlie the silty material of the Red River Valley, while throughout this region Cretaceous outcrops belonging to a period of much later date occur. Great stretches of arable land here too, lie spread before us, affording ample room for millions of pioneers ready to possess the land.

In the prolific fields of these extensive acres, industry and economy cannot fail to meet with enviable success to those who are now joining in the advancing tide of settlers across their boundless plains.

THIRD PRAIRIE STEPPE.

Crossing our plains we finally reach the third great table land of the North West, 465 miles wide on the forty-ninth parallel with an elevation of 3000 feet. It embraces an area of 131,000 square miles.

In this immense area lie our vast coal fields, so extensive that the term *Lignite Tertiary Plateau* has been applied to the region. Nearly all of the coal exposures referred to as occurring in the North West, are found in this district. As further investigations are made concerning the nature and extent of this coal bearing strata, it will be found that plenty of fuel will be supplied with but little difficulty to the future occupants of the treeless prairie land to the east.

Besides the great coal deposits of incalculable value. Vast stretches of heavily wooded districts, belts of arable land and rich pasturage areas, occur throughout the region.

As this great scene sweeps before us, shewing in succession these marked natural steps, each full of interest sufficient to supply material for a long paper, we can perceive what an attractive country this is to the enthusiastic student of nature. The rich ores of the Laurentian rocks eastward, just being unearthed are attracting thousands to seek the hitherto hidden treasures of that place. The lands of almost exhaustless fertility in the Red River Valley are rapidly being occupied. The rolling districts of the second plateau with drier and warmer soil, are eagerly sought after by the practical agriculturist. While the Third Steppe with an inexhaustible store of fuel, scarcely hidden beneath the surface, will not be less attractive as a supply to the inhabitants of woodless districts. But our work is confined to a narrower limit and our attention must be confined more particulary to some remarks on the geology of places less remote than those interesting regions to which reference has been made.

As the pioneer in our country wanders over the prairie, anxiously seeking for the surveyor's stakes, in order to enable him to locate his homestead, so we have been looking around for geological landmarks, which will enable us to ascertain our position in the series of geological strata.

Our rich alluvial soil has supplied some information, but it was not until we had ascertained the depth and nature of drift material below us, and the character of the rock over which it has been spread in ages long receded into the past, that we have been able to open the stony records at the proper place, and ascertain our relation to the past.

It is a recognized fact, that the earth's crust is composed of many layers.

These are grouped into Formations known by certain names, which are often taken from the locality where the formation is well represented, as Trenton, Hudson River, Devonian, or it may be from the nature of the rock, as Red Sandstone Gypsiferous, etc. The formations have their characteristic fossils, consequently when we find these we can arrive at a

pretty sure conclusion regarding when and how the formation was deposited, as well as the nature of the deposit. Another important fact concerning the formations is that they always occupy the same position relative to each other. For example, if we represent the formations by 1, 2, 3. 4, etc., the lower numbers occupying the lower position, we shall never find 3 be ow 2 or 8 below 5. Some may not be represented in certain localities, there may be no 4, 6, 7. but if we find 3, 2, 5, 1 they will occupy the position 1, 2, 3, 5. From this it will be readily understood that as soon as we obtain a few characteristic fossils in the neighborhood of a place we can, with considerable certainty, make out the position of the rock in the geological series. At Stony Mountain, along the Red River in the Parish of St. Andrews, and at the C. P. R. round house near Selkirk are found outcrops which supply fossils peculiar to what is known as the Hudson River and Trenton formations, largely developed in the State of New York and in Ontario, especially in the vicinity of Toronto and east along the north shore of Lake Ontario. These outcrops, no doubt, belong to the same rock as that which is found some 50 feet below the surface at Winnipeg. The characters of the deposits at Stony Mountain are closely allied to those of the Hudson River formation in other localities, while the buff-colored magnesian limestones of the Red River Valley are likely representatives of the upper part of the Trenton limestone. Both formations belong to what is commonly known as the Lower Silurian Series.

FOSSILS OF THE SILURIAN AGE.

Before a stratum of rock can be formed, in most cases it is necessary that the place upon which it is laid be beneath a body of water, especially when the rock contains the remains of marine organisms. Now, since we have a good stratum of Silurian rock some 50 feet below the surface, cropping out west and north of us, we may assume that at one time this part of the country has been submerged and raised again from the waters which covered it. On an examination of the rocks at any of the outcrops referred to, you are almost certain to find some traces of primeval life some bear a close resemblance to shells of our own day, some not unlike the backbone of fish, while others are readily recognised as corals. All these peculiar remains are traces of animals, which occupied the waters when the site of Winnipeg was the floor of an ocean.

These creatures dying their bodies became entombed in the muddy bottom, afterwards petrified and as fossils have come into our possession, serving as keys to unlock the hidden secrets of the past. As these animals, now known only by fragments of rock resemble those found only in salt water at the present time we at once infer, that the waters which covered this place in those early days were of a briny nature. Pursuing the same line of thought we can readily assume that in those days the climate was much different from the present. For as already mentioned among the inhabitants of our early sea were corals, a group of animals that can exist only in waters which have a mean temperature of 66 degrees.

The wedge shaped fossils, which usually show a series of rings with a sort of rod running through their center are called Orthoceratites. they vary in size from a few inches to three feet in length. They are the remains of animals, which lived in shells consisting of many chambers, the last being occupied by the animal, a representative of the cuttle fish family.

Many of the shells found are readily identified as belonging to both groups of mollusks, those with univalve and bivalve shells. Among the fossils of our rocks are some of wormlike form. They vary from one to several inches in length. These are the stems of what are known as stone lilies. The stone lily is what remains of an organism, which flourished in the seas of the past. Attached to the sea bottom by the expanded base of a jointed stem and surmounted by a flowerlike expansion, it bore some resemblance to a closed lily, especially when the tentacles of the animal were folded in. They seem to have been very numerous, for large portions of rock are found made up almost entirely of these crinoid stems, not uncommonly called Encrinites. It is a rare thing to find a complete form, though at almost every outcrop innumerable fragments of stems are found. We have now to call your attention to a fossil not common here, but some fragments have been found.

THIS PECULIAR FOSSIL,

not unlike a butterfly with expanded wings, is only a fragment, and represents the tail of the organism. Fragments of this nature are common, but complete forms, such as the specimens before you, are very rare. This fossil belongs to a type of very unique organisms common in the Silurian seas. From the trilobed appearance of the animal it has received the name Trilobite. These creatures seem to have been able to curl themselves up, either for protection or to enable them to sink more rapidly. So complete has the process of replacement gone on in some of these trilobite fossils that in many cases the structure of the eye is accurately preserved as can be seen by examining the specimens before you, which show all the parts very distinctly. Some peculiar, tiny saw-shaped markings also occur on the rocks of the Hudson River formation; these are known as Graptolites. Upon the tooth-like projections small cups were situated, each of which contained a small organism of very simple structure. A whole colony of these creatures were located upon the axis, and with their tiny tentacles were able to whip food into their rudimentary mouths. These fossils occur in a variety of forms, some with a single row of tooth-like projections, others with a double. Many are not unlike a leaf and a few consist of many axes radiating from a common centre. The Graptolites and Trilobites are of especial interest in determining the age of a deposit. s yet none have been found in strata above the Lower Carboniferous, consequently when we find them on the surface we know at once that we are below the coal measures, and as far as coal is concerned we will seek for it in vain. Coal may appear above these fossils, but it has not been found below them. All these creatures, which inhabited the sea in those early years of the world's history have long been extinct, though at one time they seem to have thronged the sea in myriads.

The animals to which reference has been made were among the leading types then in existence; for at that period in creation no insects, no fishes, no birds, in short, none of the higher animals had as yet made their appearance. Life was confined chiefly to the sea, and of a very rudimentary nature. The only plants were seaweeds, and, as noted, the animal kingdom was but scantily represented, the genera and species were limited, but the individuals were very numerous. Up to this time stillness was a leading feature in nature. No sound was heard except the lashing of the waves on the lonely shores, or the howling of winds unimpeded in their course across the bleak and solitary rocks. The continent, like its species, was submarine in its mode of existence. It was outlined, but not till long periods had passed, during which great physical disturbances took place, was the present form brought into existence. Such was the dumb state of affairs when the rocky foundation of our ambitious city was laid.

THE WINNIPEG DRIFT.

Having directed your attention for a short time to the solid rock lying beneath our clay deposits, it now remains to consider briefly some things in reference to this loose material, and endeavour to explain how it has been formed and reached here in the finely divided condition we find it. The presence of boulders in this so-called drift material, of the same composition as rocks north and east of us, and the salty nature of much of the water found in some wells would seem to indicate that our soil has been derived from other sources than the disintegration of the rock beneath, and that much of our clay is an alluvial deposit brought here in past ages from districts quite remote from Winnipeg. From an interview with Mr. Piper, known as having an extensive experience in well boring throughout the city, we have learned that the average nature of a vertical section of the deposits, overlying the sold rock here is as follows:

1. Surface mould, one to four feet, dark color and exceedingly fertile.

2. "Yellow gumbo," two to three feet, a very sticky form of yellowish clay which usually holds considerable water.

3. Dark gray clay, thirty to fifty feet, with boulders scattered throughout, some of them four feet in diameter, and chiefly gneissoid, and no doubt derived from Laurentian rocks.

4. Light-colored clay, one to three feet, containing many small stones.

5. Hard pan, two to ten feet, a very solid and compact form of clay.

6. Sand, gravel and boulders, five to twenty-five feet.

7. Angular fragments, one to three feet, usually limestone, and largely derived from the solid rock which lies immediately below it.

This loose material is far from being uniform, and varies so much in its arrangements that scarcely any two borings show the same distribution. Sometimes there is little or no hard pan, while in other parts it is several feet thick. However, as a usual thing, these seven forms of strata are passed through in boring, and varying in thickness to the number of feet already mentioned.

SERIES WANTING.

After the formation of the Hudson River limestone, there seems to have been a great break in the deposition of rock in this part of the country, for in other parts of the Dominion we find hundreds of feet in thickness, being deposited while the Red River was, geologically speaking, at a stand still. Such might have happened by its being raised above the sea and continuing so, while other places were submerged and in a position to receive further additions to their strata. It may have been, though not likely, that deposits were laid down and afterwards disappeared by denudation during long periods of time, or as some have thought the place may have been located in deep water and situated far beyond the reach of deposits being added, while they were forming rapidly nearer the shore. The first reason for the absence of deposits, is that which we are inclined to accept. Whatever view may be the correct one, is open for consideration, but one thing is certain, formations of later date are represented elsewhere, while here not a trace of them is found. Throughout the coal forming age little or nothing was being added to our strata, while other places were receiving from Nature's liberal hand donations, which would serve as fuel in time to come. True, coal has been found in the North-West, and lately we have been informed by some of our eager news seeking reporters it has been discovered near Selkirk But it must be remembered that our coal belongs to a much later period than what is known as the "Coal Measures." The latter are supposed to have been deposited toward the close of the Palæozoic age, while the former belongs to the Cainozoc or Tertiary period; in other words, using the terms Primary, Secondary and Tertiary as applied to the various comprehensive periods in geological history, we find the "Coal Measures" in the Primary and the Lignite of the North-West in the Tertiary.

The extensive Coal age passed away without the Red River Valley receiving a single seam. The age of Chalk ended, and still our strata were not increased. Whole formations thousands of feet in thickness were built up and millions of years passed away while the rocky foundation of Winnipeg seemed to idly wait without further addition, beyond the influence of the sea. Still the surface of our rock would be undergoing some changes. Winds may have exercised an influence in disintegrating the rock. Rains, too, may have battered upon the exposed surface now no longer beneath the sea. The action of these forces, together with frost during the countless ages employed in building up immense rock formations elsewhere would aid to some extent in preparing the ground material of which our soil is composed and which at present hides our solid rock from view. But now, after a great portion of the first geological age of the world, the whole of the second, and much of the third had passed away, and millions of years had glided by, we find a new scene about to take place, in which this part of the Dominion performed no insignificant part.

THE GLACIAL AGE.

We have now reached the glacial period in geological history, a time when mighty icebergs and immense rivers of ice are supposed to have swept over the northern part of our continent, wending their way southward, loaded with thousands of tons of rocky material, and grinding the rocks over which they passed. It is supposed that during the glacial period the northern portion of the country was raised above the level of the sea, so much so that a line of perpetual snow was formed. Where such occurs snow must accumulate, till finally the force of gravitation starts the mass. This is the origin of a glacier or ice stream. Its movements may be slow, sometimes only eight or ten inches per day, consequently it will be a long time in making much headway down the moun-

tain side; but onward it moves with irresistible force grinding over everything in its course—one gigantic body of ice, sometimes miles wide and 600 to 700 feet thick. Such a glacier can be seen at the present time in Greenland. If the snow line is only one or two thousand feet above the sea level, the glacier from it reaches the sea before the temperature of the lower region is sufficient to melt it. This immense body of ice will continue pushing out into the water grounding upon the sea bottom until the depth of the water is sufficient to float it. As soon as this occurs portions of the glacier will break away and float off, forming what are known as icebergs; hence, the origin of icebergs is, to a great extent, the terminus of a glacial stream whose mouth enters the sea. This phenomenon is now seen in countries far north, where the line of perpetual snow is near the sea. In such places glaciers appear issuing from the mountain tops, passing onward through valleys until they reach the sea, where the ends break off and float away as icebergs into warmer regions. But in countries where the snow line is much higher we notice different phenomena. The glacial stream never reaches the sea in the form of ice, for long ere it gets the temperature of the atmosphere has melted it, and a river of cold water flows into the country below, and becomes in many cases the source of a river. Such is the origin of the Ganges, which rises at the base of the Himalaya Mountains from the end of a glacial stream.

Could we examine the rocks upon which this immense body of ice has been grinding in its course, we would find it very much scratched and abraded. As the glacier moves on through the valley, portions of rock are continually dropping upon it from the heights above; consequently, where the the glacial stream is long, it is loaded with fragments of rock, which, in transportation, by continual grinding, become more or less rounded. If the glacier terminates before reaching the sea, these rounded pieces of rock will be deposited near its mouth and where it has contained for many years an immense heap of stones will be formed, which in years after when the aspect of affairs has changed, may have much the appearance of a gravel pit or line of boulders seen in some parts of the country.

GLACIAL DRIFT.

The question which presents itself now is, has this part of the Dominion experienced these phenomena, and if so, to what extent? If we were to remark on seeing a man's footsteps upon the sand that a human being had been there, no one would doubt it though years had elapsed since the person who made them passed that way. Just so with regard to glaciers being in the North-West. Their traces are here and though absent themselves have left silent monuments, which indicate their course from northern regions to those farther south of us. North and west of us near Nelson River, Knee Lake and places in that vicinity glacial striæ, in other words, markings upon the rocks in the form of grooves, scratches and polished surfaces, such as are found upon rocks where glacial action is now going on, have been observed in over seventy-four places widely separated from each other. They all indicate a course from north to south, in a more or less south-westerly direction. Of all observed only three show a course south-east. North-west of us, in the vicinity of Lake Athabasca, especially at the western end the rocks present all the characteristics of having undergone glacial action. If the surface of the rock, which crops out at Stony Mountain, be closely examined we think that in some places glacial striæ will be observed. In many parts of Ontario rocks with abraded surface are very common. So uniform and over such broad areas do these glacial markings occur that there can be no doubt as to their origin, especially when we remember that similar markings are being made on the surface of rocks in other countries which we know are now undergoing glacial action. See Greenland, Alps, Norway and Himalaya Mountains. Although our soil here is comparatively free from stones, still a little west of us many stones are seen which are not of the same composition as the rock below, but precisely the same as those lying north and east of us. By some agency or other they have been transported here, and as no view has yet been given to account for their presence so far south of

the original rock, we are forced to accept the theory that they have reached their present location through the agency of ice, either in the form of glacial streams or icebergs: that those gigantic bodies of ice at one time moved over this region of country loaded with rounded fragments of rock, some of which lie on the prairie west of us and many occur in the clay upon which Winnipeg stands. Not long ago we were shown a piece of rock which had been broken off a boulder sixty feet below the surface. It could be readily identified as a piece of gneissoid rock, such as occurs in northern districts. The soil which we cultivate dates much of its origin from this period, which is computed by Sir Charles Lyell to have lasted about 150,000 years, sufficient time to grind up much of the limstone below us and the rocks farther north. The material ground up during this long period of time would be scattered in post-glacial days by the torrents flowing down from upland districts to lower, no longer within the icy grasp of an Arctic climate. Still later, silty materials may have been laid down on the bottom of an inland sea, into which the drainage of a surrounding district poured, and thus be derived our deposits which overlie the rock below. The lower clay beds being a glacial and post-glacial deposit, while the upper largely lacustrine in their origin. From what has been said you will observe that the site of Winnipeg must have been at one time covered by the waters of a nameless sea, a sea along whose shores no mortal ever trod, a sea inhabited by animals extinct millions of years ago. Further, that it was raised again above the waters, and for countless ages its rocky surface exposed to the weathering action of wind, rain, snow and frost.

That either icebergs floated and stranded along the shore of a vast body of water, which again covered it, or that glacial streams, coming from the north glided along, polishing and abrading the surface of the rocks over which they passed.

WINNIPEG WATER.

After an interval of some time, this place seems to have been again submerged by the waters of an inland sea, the shores of which extended along the elevated ridge from Pembina to Riding Mountain. Into this great lake the rivers of the North West poured their muddy waters, charged with saline substances derived from deposits over which they passed. This may have continued for a long time, at least long enough to form the alluvial deposits of the Red River Valley, which we find now largely made up of finely divided clay, strongly charged with saline substances.

This inland sea has passed away, whether by subsidence of land north of us or the elevation of that on which we stand, we cannot say, but the fact presents itself that all that remains now is the river and the lake into which it empties, with a country on either side showing all the characteristics of a deposit which settled on the bottom of a lake no longer in existence.

Viewing the formation of the Red River Valley from this standpoint we can scarcely hope to get good water in our clay beds, which are no doubt impregnated with impurities derived from the river drainage of the saline deposits west and north of us. A comparison of an analysis of the Red River and that of the Assiniboine will at once show how widely they differ. In each case the number of grains in an imperial gallon is given:

	Red River.	Assiniboine
1. Organic matter.....	5.28	7.71
2. Calcium sulphate..	2.42	4.39
3. Calcium carbonate.	10.50	7.05
4. Iron, alumina, silica	3.78	1.09
5. Magnesium sulphate.....	....	7.81
6. Alkaline salts, chiefly as chlorides.....	5.18	9.75

From an examination of this analysis it will be observed that the water from the Assiniboine contains 30.09 grains of solids in an imperial gallon, while that of the Red River contains only 21.88. The former carries down the drainage of the west, where many of the deposits are largely impregnated with alkaline salts, while the latter flows chiefly over rock composed of limestone; hence the Red River has more carbonates and less sulphates. The presence of so much magnesium sulphate and Epsom salts in the water of the Assiniboine is rather striking. If we wish to secure good water, we must bore through our impure clays into solid rock beneath, or bring it from a distance. Such might be obtained from Lake of the Woods, which is supplied from rivers whose drainage is over rocks of the Lan-

rentian series, upon which water has but a slight solvent effect and consequently of a purer and softer nature than that which has passed over limestone formations.

As already observed there are 30.09 grains of solids in a gallon of water from the Assiniboine 21.88 in one from the Red River, while in water from the Ottawa we find only 4.84 grains and that from the St. Lawrence 11.74. The Ottawa drains a country in which the rocks are largely of the Laurentian series while the others come more in contact with limestone rocks.

The hardness of these waters is represented according to Clarke's method as follows: Assiniboine, 10.5°; Red River, 9°; St. Lawrence, 3.5°, Ottawa, 2.3°.

This shows conclusively the marked difference between waters, both as to hardness and purity which have passed over rocks widely different in chemical composition, and that if we seek pure water we must have its source in rocks upon which water has but little effect.

PRACTICAL CONCLUSIONS.

Let us now sum up the practical information derived from the geological gleamings gathered from an examination of our solid rock and the material which covers it.

1. The constituents of our soil have been derived from the disintegration of Silerian limestone beneath, exposed to agencies at work during the countless years that preceded the glacial period after the deposition of these rocks, also from materials obtained by the grinding up of Laurentian rocks at a distance, during the glacial epoch and transported in glacial and post-glacial days. To the ground up material of these long periods mixed with boulders, must be added the rich alluvial deposits brought down by rivers and spread over the bottom of a lake which seems to have covered at one time the whole Red River Valley. These materials, together with decomposed organic matter largely derived from plant growth of comparatively recent time, colored dark no doubt to some extent, by the charred remains resulting from repeated prairie fires, supply the constituents of a soil which, under the crucial test of the chemist, and the experience of the practical agriculturist has been proved to possess wonderful fertility.

The alkaline salts at present found in some parts of our Valley and apparently obnoxious to vegetation, must pass away as the land comes under cultivation by skilled farmers. These substances being easily soluble, readily pass down into the sub-soil from which they will be carried off by a proper system of drainage and what may still remain will soon be exhausted by the proper application of manure.

The experience of the few farmers that have as yet tilled these patches with "alkali" shows that manure destroys it and that in Manitoba manure is valuable as well as in the impoverished districts of eastern provinces.

2. That most of the rounded boulders in our days and those on the surface west of us have been transported from rocks of the Laurentian series at a distance, through the agency of ice.

3. We need not be in suspense regarding a supply of good water to our city however large it may become. If the wells, with their sources, in some cases, in the sands of the lower strata in others, the solid rock, are not sufficient, can we not look forward to a time when the characteristic energy and enterprise of our citizens will undertake to have a supply brought from the pure waters of the Lake of the Woods to the inhabitants of the great metropolis of the North West! Water brought from Lake Winnipeg, as some have suggested, can scarcely be expected to equal that from the east since it connects with a system of lakes into which are now flowing, waters highly charged with salt and other mineral substances. These lakes receive the saline deposits brought by the river drainage of the west and which in early years reached here, so as to impregnate Winnipeg clays as we find them at the present time. Lake Winnipeg receives the waters of rivers

which drain an area of 400,000 square miles in parts of which are found pools and lakes containing salts of sodium and magnesium that must find their way into these waters and affect their chemical composition to some extent. The waters of the Red River are comparatively good, if rid of the suspended material. This is observed to be the case especially during the winter months when little or no mud from its banks dissolve and mingle with the stream. Another objectionable element likely absent to a great extent in winter is organic matter which is not so readily formed at a low temperature as during the summer months.

The mud and other suspended impurities of our river water might be easily got rid of by filteration, and very good water be obtained. The calcium carbonate in the water can scarcely be considered a deleterious substance. To some this is a necessary ingredient and nearly all spring water possesses more or less of this compound.

This brings to a close our Gleanings from the Geology of the Red River Valley. There are some things which we desire to investigate further, and when more leisure occurs, we may again trespass on your patience by giving additional evidence regarding the history of the country immediately surrounding Winnipeg, long before the advent of man upon the earth.

OBSERVATIONS BY MEMBERS.

A desultory discussion followed the reading of Mr. Panton's paper, in which remarks of more or less interest were made. Rev. Professor Bryce said there was a possibility of Tertiary strata being found on some of the islands of Lake Winnipeg in which coal might be found. Lumps of coal had also been taken from the Roseau River, an eastern tributary of the Red River, and some geologists had surmised that they had come from lignite coal beds in Tertiary strata formed in some phenomenal manner near the head waters of the Roseau. The likelihood of coal being found in any quantity in either place was very small. He also spoke of the inferiority of the water of the Assiniboine to that of the Red, but pointed out the unsuitability of either for summer use. A supply would have to be procured from some other source. Mr. McArthur referred to the good quality of the water in two wells on the Red River flat which did not reach the rock, and also asked a question as to the relative purity of water from flowing and deep wells. Mr. Panton suggested that the two wells spoken of, and the various flowing wells which gave pure water, must tap the quicksand underneath the hardpan, through which water percolates from the surface some distance away, outside the region in which saline properties abound in the earth. A gentleman in the audience remarked that wells sunk to the same bed of quicksand some distance away east of the Red River yielded water of the same purity. This water might therefore enter the stratum of sand where it was exposed in the shores of some of the eastern lakes, and be conveyed by it, underneath the hard-pan, to the point where the wells are sunk. In reply to a question as to petroleum deposits Mr. Panton said crude petroleum in quantities was not found in the Silurian rocks. Utica shale, a rock of the Trenton formation, which occurs at Oshawa, Collingwood, and other places in Ontario, is permeated with petroleum, but is not worth working. The great petroleum deposits occur in Devonian strata, and it is in rocks of this formation that the crude oil is found on the eastern shores of Lakes Manitoba and Winnipegoosis.

Another question was put in order to ascertain how it was that fish remains were found in the Souris District if as the lecturer had said our rocks were deposited before fish came into existence.

This was readily explained by remarking that in the Souris District the deposits were of a much later date than those around Winnipeg and that the presence of fish there was quite in harmony with the teachings of geology bearing on the strata of that region.

A vote of thanks to Mr. Panton for his paper, proposed by Mr. Whitcher and Mr. Ashdown was adopted. The President took occasion to congratulate the Society upon having the opportunity of listening to a paper prepared in so popu-

lar a form on so important a subject. Mr. Panton said that at some future time he would probably be able to contribute a paper on the evidence of the glacial period, as exhibited in the North-West. The President then announced that at the next meeting a paper would be read by the Rev. Professor Bryce on the subject, "First Across North America." The meeting was then adjourned.

A number of large illustrations of fossils found in the Silurian rocks aided greatly in making the lecture interesting and instructive.

The sketch showing the various strata of which the Winnipeg drift is composed illustrated very clearly their nature and arrangement.